INSTRUCTION BOOK
Model 84

STANDARD SIGNAL GENERATOR

Measurements Corp. Boonton, N. J.

MP MASTER
MA25149

CONFIDENTIAL

OPERATING INSTRUCTIONS FOR THE MODEL 84 STANDARD SIGNAL GENERATOR

I. General:

The Model 84 covers the carrier frequency range from 300 to 1000 megacycles. The output is continuously variable from .1 microvolt to .3 volt. A special built-in modulator provides either sinewave or pulse modulation with provision for external synchronization if desired. The operation and use of this instrument involves some care and thought on the part of the user. It is suggested that the following instructions be carefully read before proceeding with the operation of the instrument.

II. R.F. Oscillator Unit:

The r.f. oscillator uses a W.E. 368-AS tube in a modified "butterfly" tuning circuit. The filament current of the 368-AS is indicated on a panel meter. If the current does not come within the red area between 4 and 4.2 amperes, it can be reset by means of the set screw to the right of the panel ammeter. Note: When the instrument is first turned on, rather high filament current will be taken by the tungsten filament until it warms up. If the instrument is to be turned on and off frequently, it may be advisable to reduce this initial current by turning the set screw to the left until the instrument has warmed up. If the filament current is

operated below 4 amperes, the tube may not oscillate over the entire frequency range; if the current is set over 4.2 amperes, a relaxation oscillation occurs at approximately 900 to 950 megacycles under certain conditions of operation. This relaxation occurs at approximately 1 megacycle rate as determined by the grid leak and grid capacity time constants. Under certain conditions this may be accompanied by a 20 cycle relaxation. Usually these effects are only present when using either cw or sine-wave modulation.

Two carrier frequency controls have been provided: coarse and fine tuning. The frequency scale is directly calibrated in megacycles, and in addition a red counter scale together with the 0-100 fine tuning dial provide a long linear scale suitable for small frequency increments necessary in selectivity measurements. Since the shaping of the tuning elements provides a reasonably straight line frequency distribution, white celluloid rings can be supplied by Measurements Corporation and slipped on over the 0-100 dial and directly calibrated in megacycles deviation about a particular center frequency. Thru the use of spring takeup devices, the backlash in the tuning system has been held to approximately 1 dial division. If closer settings are desired, it will be best to always turn the dial in the same direction. The calibration accuracy of the carrier frequency dial should be better than 1/2% over most of the range. At the higher frequency end this may not be so, if another 368-AS oscillator tube is substituted for the one supplied with the instrument. This should not cause

any particular concern, however; since a Standard Signal Generator is a standard of voltage not a standard of frequency, Fortunately the carrier frequency stability of the Model 84 is rather good. Proper ventilation is essential since the instrument consumes over 200 watts. Under no circumstances should the ventilating louvres be closed while the instrument is in operation.

Attenuator System:

The Model 84 uses a mutual inductance type attenuator with a transverse type magnetic field adjusted for minimum attenuation. This method of operation is essential at the higher frequencies, since all other components of magnetic field are attenuated much more rapidly, and it is not necessary to bother about their presence. The design of the oscillator has been carefully coordinated with the requirements of this particular type of attenuator system.

A rack and pinion couple the attenuator to the output dial. A movable type of fiducial indicator on this dial is provided for setting the output at a high level on the output meter and backing off for lower values of output. A special crystal rectifier is used for high level indication. A pushbutton immediately below the output meter gives a quick check on the crystal calibration. An adjusting screw below this meter can be used to reset the crystal calibration if necessary. (Note: the external voltage regulator should be used when checking crystal calibration.)

After the carrier frequency has been set, the output dial should be turned clockwise until a reading is obtained on the output meter. (Note: this should not be done on "pulse".) Set the meter to 100K (100,000 microvolts); then set the fiducial on the output dial opposite 100K on this dial by means of a lever below the dial. Next, turn the output dial counter-clockwise until the desired level is read opposite the indicator. Output from 100K to 300K is read directly on the meter, since the attenuator places too much load on the oscillator for accurate calibration of the output dial above 100K.

The output system is designed to operate into a terminated 50 ohm transmission line. The output voltage indicated by the attenuator is the voltage which appears <u>across</u> the generator cable jack when it is terminated in 50 ohms. This is contrary to the usual concept of a <u>zero</u> impedance generator in series with some particular terminating resistor. The output jack as supplied on the standard Model 84 is carefully designed so as not to introduce a discontinuity even at 1000 megacycles.

Four different types of connecting cables of 50 ohm surge impedance are supplied with each instrument.

Two of these have standard 14195 type plugs for use in connecting the sync input and sync output jacks -- these will be discussed later under the modulation unit. One cable has the newer 14268 connectors on both ends. This cable should be used if possible; however, some older equipment may require the use of the fourth adapter output cable which has a 14195 plug on one end and a 14268 plug on the other end. The use of a

14195 type connector will definitely indroduce reflection loss at 1000 megacycles, unless means are provided for tuning out the mismatch.

A 10 db pad is built-in the output jack and crystal assembly on the Model 84 in order to minimize the effects of slight mismatch present in the most carefully designed connectors. This 10 db loss is properly accounted for in the factory calibration of the instrument. It may be well to give some careful attention to the use of isolating pads in high frequency measurements to avoid reflection losses.

If it is desirable to operate the instrument into cables having a surge impedance other than 50 ohms, The Measurements Corporation will endeavour to supply external pads with proper plug adapters where necessary. In general, it will be necessary to take into account the loss engraved on the particular pad, although it is possible to paint the pad red or green and put an extra mark on the fiducial in the same color. This latter solution is practical because of the logarithmic calibration of the output dial. Under such conditions the output meter and black fiducial would be set at 100K as described above, but the actual output across the special pad would be read opposite the fiducial mark of the same color. This would automatically take into account the loss in the matching pad.

Unusual care in the application of shielding and filtering has reduced the stray field or "leakage" in this instrument to neglibile values. Even without the outer case, the leakage

more than a few inches away from any part of the instrument should be less than a microvolt. Under usual operating conditions it has not been possible to locate any leakage at all. We feel that leakage has been reduced to less than .1 microvolt, altho it is difficult to check this at all parts of the carrier frequency range because of limitations in the design of receivers at the present time. Any comments with regard to leakage will be most welcome.

Modulator Unit:

The modulator controls are located to the left of the main panel. A vertical row of pushbuttons selects the desired type of modulation. When the button marked "pulse" is depressed, pulse modulation as determined by the four engraved dials can be obtained. It is necessary to first set the desired attenuator output on cw or sine-wave modulated carrier as selected by pushing any of the other five buttons, since the crystal output metering arrangement will not indicate properly the peak value of pulse output. Internal design of the modulator is such that the same value of plate pulse peak is automatically supplied as is used on cw. This will result in the same peak carrier pulse as in cw operation.

The pulse repetition rate or frequency is determined by a free-running type of hard tube multi-vibrator. The frequency can be adjusted anywhere between 50 and 100,000 cycles by means of the 50 to 1000 cycle dial and multiplier dial. If desired, the frequency can be synchronized to an external source by means

of the jack and control knob immediately above it marked "sync in & mod". When synchronizing to an external frequency source, care must be exercised not to use too much sync input and overdrive the multivibrator or else the stability may be adversely affected. It is well to set the frequency first by means of the directly calibrated dials and then slowly increase the sync input until the frequency "snaps into lock" with the external supply.

Synchronizing output up to approximately 50 volts either polarity of adjustable magnitude is available from another panel jack below the control knob marked "sync out". The carrier pulse can be delayed with respect to this sync pulse by adjustment of the dial marked "pulse delay". This is convenient for inspecting the leading edge of the carrier pulse. The carrier pulse width can be varied by the dial marked "pulse width".

At 1000 megacycles the carrier can be pulsed down to 1 microsecond with zero delay, but as the carrier frequency is lowered the minimum pulse width and delay increase because of oscillator tank circuit limitations, i.e. capacity increase faster than inductance, especially below 500 megacycles. At 500 megacycles the minimum pulse width is approximately 2 microseconds and there is about .25 microsecond initial delay. As the carrier is decreased down to 300 megacycles, the minimum pulse width approaches 10 microseconds and the minimum delay approaches 5 microseconds. If narrower pulses are attempted at these lower carrier frequencies, the oscillator simply doesn't oscillate.

It will be noted that certain portions of the calibrated pulse dials have been filled in red. This is to serve as a constant reminder that at the higher repetition rates, it is not possible to use long pulse widths. For example at 100,000 cycles, the maximum possible pulse width is 5 microseconds, however for best operation it is best not to attempt pulses longer than 2.5 microseconds. Likewise if pulse delays greater than five microseconds are attempted at this high repetition rate, the sync output "trigger" or "flip-flop" will merely skip a beat and sync will be available only every other cycle. This may cause poor synchronization of the oscilloscope sweep.

The "sync out" and calibrated pulse dials have no effect on the operation of the instrument except when the "pulse" button is depressed. In order to secure sine-wave modulation of either 400, 1000, or 2500 cycles, the button marked with the desired frequency should be depressed. The amplitude of sine-wave modulation is adjustable by means of the knob marked "sync in & mod" and indicated on the modulation meter after proper zero adjustment. After a desired carrier frequency has been set, the button marked "off" should be depressed and the modulation meter set to zero by means of the control knob marked "mod zero". Then the desired sine-wave modulation frequency button should be depressed and the modulation set to the desired level by means of the knob marked "sync in & mod".

When using audio frequencies other than 400, 1000, or 2500, the pushbutton marked "ext" should be depressed and the desired

audio frequency fed into the jack below the knob marked "sync in & mod". This same knob serves for adjustment of the modulation level when using an external source. It is possible to modulate the instrument at levels greater than 30%; however, there is some distortion and it was not deemed wise to calibrate the meter at higher levels.

The modulation meter in the Model 84 reads the audio component of r.f. oscillator grid current. It was found that this was the most accurate measure of modulation level for this particular type of oscillator circuit. Since a portion of the d.c. grid current is passed thru the meter to determine the "zero setting". it is necessary to reset the modulation zero as outlined above after changing the carrier frequency.

Miscellaneous:

An external saturated-core type of voltage regulator is supplied for operation of the instrument on 117 volts 60 cycles. If operation is contemplated from a portable power supply or power supply having a frequency differing from 60 cycles, it is best to operate without this regulator. Although a switch is provided on the panel of the Model 84, it will be necessary to pull the power plug out to disconnect the regulator from the power line when the instrument is "turned off", otherwise the regulator will continue to draw power from the line.

Since a.c. is supplied to the filament of the r.f. oscillator tube, some hum ripple results in the carrier. This is chiefly frequency modulation. Its magnitude is approximately 40 kc

peak to peak at 400 megacycles. If this order of magnitude is objectionable, it may be necessary to remove the instrument from its outer case and attach a heavy lead to the filament rheostat instead of the lead from the power transformer. This lead together with a suitable ground lead can be threaded thru the power supply hole in the rear of outer case, and attached to a large two volt battery cell.

Measurements of incidental frequency modulation at 30% amplitude modulation indicate approximately 75 kc peak to peak at 300 megacycles and 130 kc peak to peak at 400 megacycles. The amount of frequency modulation will increase as the carrier frequency is raised to 1000 megacycles. No difficulty has been experienced with f-m when using a receiver having a pass-band of approximately 500 kc at 2 times down at 1000 megacycles.

If it becomes necessary to change the oscillator tube, it will be necessary to remove the instrument from its case and remove the two round oscillator shield can covers. Then loosen the two set screws and clamp which secure the upper end of the oscillator filament "quock" and push the "quock" free from the mounting bars. Next, remove the screws which hold down the upper oscillator chamber flange and lift off the upper chamber. The tube pin clamps can now be loosened and a new tube mounted in place. Care should be taken to replace the "quock" and upper chamber as before. Try the new tube for output over the tuning range before replacing the shield covers, for not all type 368-AS tubes will operate satisfactorily. Care should be taken not to allow any foreign

matter to drop into the lower portion of the tuning unit, or else the tuning rotor air gap may be shorted. A soft brush is helpful in removing chips from the rotor.

Some of the tubes in the pulse generating circuits may require care in replacement. It is well to avoid unnecessary shifting of tubes, and the pulse frequency, width, and delay should be checked after tubes have been replaced.

Fuses: A panel fuse is provided on the Model 84. This should be replaced only with a 3 ampere type 3AG.

In an instrument as complex as the Model 84 some need may arise for occasional service, altho every practical precaution has been taken by the manufacturer to use nothing but the best: oil-filled and sealed capacitors, thoroughly potted transformers and reactors, ample insulation, all tubes within ratings, etc. We welcome correspondence with regard to component part failure or other difficulties, for it is only by careful study of such complaints that better instruments can be built. After experience has been secured from field use, a more complete instruction book and service manual will be compiled and sent to the users of the 84.

MODEL 84 U. H. F. STANDARD SIGNAL GENERATOR

TENTATIVE SPECIFICATIONS:

Carrier Frequency Range:

300 – 1000 megacycles. Frequency scale individually calibrated.

Modulation:

A.M. – Choice of 400, 1000 or 2500 cycle internal and external up to 30 kc. through built-in modulating amplifier. Percent modulation is directly indicated up to 30% on panel meter.

Pulse— Repetition Rate continuously variable. 50 to 100,000 cycles per second in three ranges.

Pulse width continuously variable and calibrated from 1 to 50 microseconds.

Pulse Delay (with respect to synchronizing output) continuously variable and calibrated from zero to 50 microseconds.

Synchronizing Input on either sine wave or pulse.

Synchronizing Output either polarity variable up to 50 volts.

Output System:

Continuously variable from .1 to 100,000 microvolts.

Impedance fixed at 50 ohms. (14268 connector).

Dimensions:

Width 26", Height 12",
Depth 10"

Weight:

Approximately 125 pounds, including external line voltage regulator.

Fuses:

One type 3-AG 2 ampere

Power Supply:

117 volts 60 cycle.

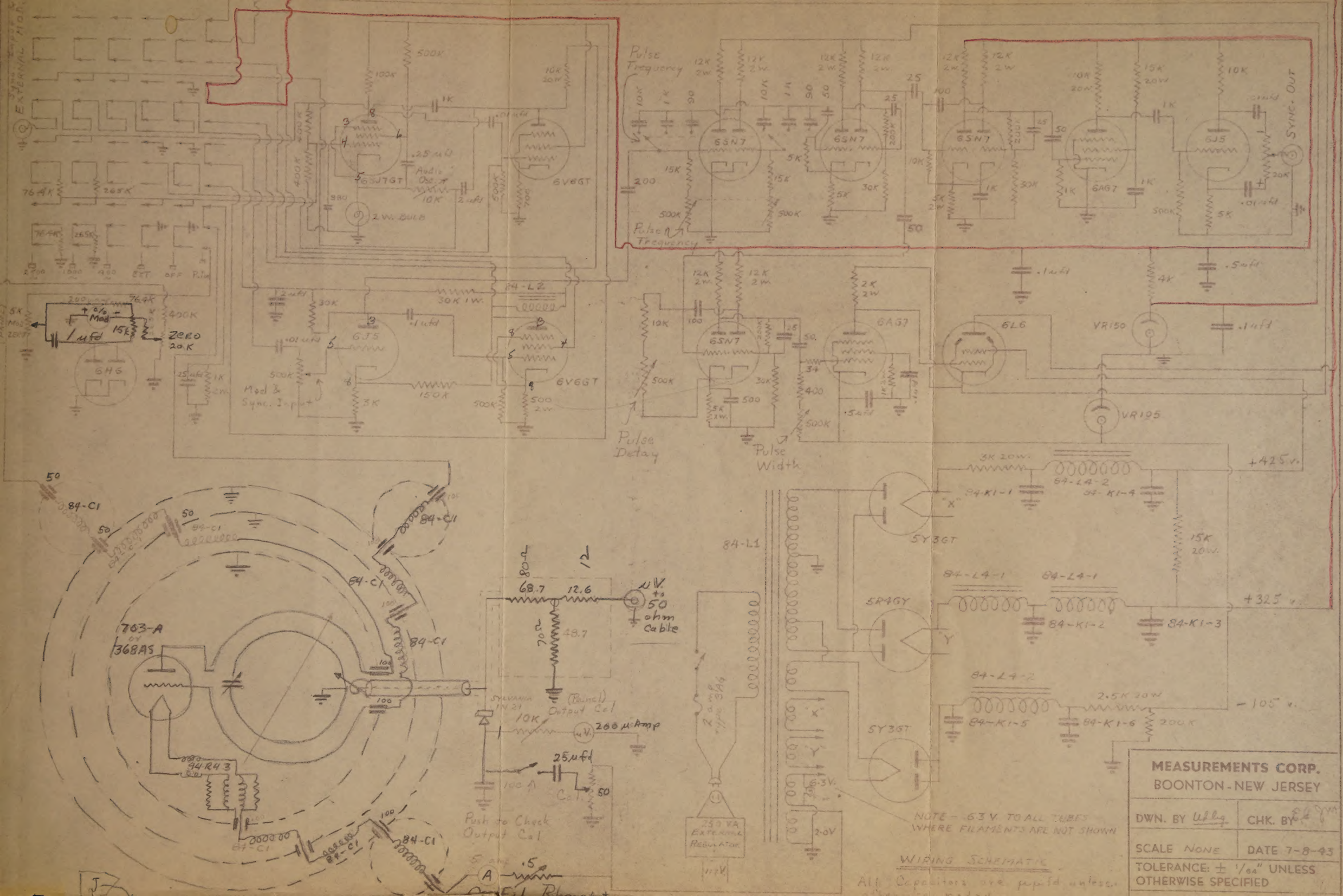
Tubes:

One type 368AS
One type 5R4GY
Two type 5Y3GT
One type VR-150
One type VR-105
Two type 6J5GT
Two type 6AG7
One type 6SJ7GT
Two type 6V6GT
Four type 6SN7GT
One type 6H6
One type 6L6

Notice: *these specifications are subject to change without notice.*

MEASUREMENTS CORPORATION

BOONTON NEW JERSEY



NOTE - 6.3 V. TO ALL TUBES WHERE FILAMENTS ARE NOT SHOWN

WIRING SCHEMATIC

All Capacitors are mfd unless...

MEASUREMENTS CORP. BOONTON - NEW JERSEY	
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SCALE None	DATE 7-8-43
TOLERANCE: ± 1/64" UNLESS OTHERWISE SPECIFIED	

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